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Significant Gender-Related Differences in Radiofrequency Catheter Ablation Therapy

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OBJECTIVES We investigated possible differences between male and female patients regarding ablation therapy.

BACKGROUND Gender-related differences might have a major impact on different aspects of radiofrequency ablation therapy. Data on this topic are very limited, focusing almost exclusively on success and recurrence rates.

METHODS The study population consisted of 894 consecutive patients who underwent catheter ablation of accessory pathways (n = 519) and/or atrioventricular nodal re-entrant tachycardia (AVNRT) (n = 379). There were 418 (46.8%) male and 476 (53.2%) female patients.

RESULTS Female patients were referred for ablation later than male patients (185 ± 143 vs. 157 ± 144 months after onset of symptoms, $p < 0.001$) and after having been given more antiarrhythmic drugs (1.6 ± 1.2 vs. 1.3 ± 1.1, $p < 0.001$). Women were more symptomatic, with a higher number of patients having >1 tachycardia episode per month (80.3% vs. 70.3% in men, $p < 0.001$). Fluoroscopy time, radiofrequency applications, and procedure duration were similar in male and female patients undergoing accessory pathway ablation as well as in male and female patients undergoing AVNRT ablation. No difference was seen in success, complication, and recurrence rates between men and women.

CONCLUSIONS Physicians and/or patients tend toward a more conservative approach in female patients. Women are referred for ablation later than are men, after a longer duration of symptoms, and after having been given more antiarrhythmic drugs. However, potential concerns on behalf of physicians or female patients do not seem to be justified: ablation procedures in women had equally high success, low complication, and low recurrence rates as those procedures in male patients. (J Am Coll Cardiol 2003;42:1103–7) © 2003 by the American College of Cardiology Foundation

Radiofrequency catheter ablation provides curative treatment with excellent success and minimal complication rates for patients with supraventricular reentrant tachycardia (1–4). Therefore, in the present day it represents a treatment modality of first choice for these patients. Despite the high numbers of procedures performed worldwide, published reports contain only few data regarding potential gender-related differences, focusing almost exclusively on success and recurrence rates (4–6). However, differences between male and female patients might have a major impact on different aspects of ablation therapy.

Women have smaller heart size and smaller coronary artery diameter than men (7–10). Such anatomical gender differences have been considered to be one of the possible factors explaining the findings of previous investigations reporting a worse outcome of coronary artery bypass grafting (CABG) but also coronary intervention in female patients (9,11–14). Radiofrequency ablation is based on catheter manipulation inside the heart chambers. Therefore, smaller chamber size in women could in theory affect the ease of performance of ablation procedures as well as their outcome, including success and complication rates.

For male and female patients, different referral and treatment policies with a more conservative management approach and a potential underuse of medical resources in women have been demonstrated in various fields of medicine and cardiology (15–23). Previous studies have reported that women with coronary artery disease (CAD) undergo fewer major diagnostic procedures and are referred for coronary revascularization less often and later in the course of their disease, having more severe coronary symptoms than men at the time of referral (15–18). Other investigations have shown that women with acute myocardial infarction (MI) have a longer prehospital delay, receive reperfusion therapy less often, and undergo less noninvasive and invasive procedures than men (19–22). Similar differences have also been reported in other fields of medicine (23). As for radiofrequency catheter ablation, there are no reports addressing this issue.

The aim of this study was to investigate possible gender-related differences in a large series of patients undergoing

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Abbreviations and Acronyms

AV = atrioventricular
AVNRT = atrioventricular nodal re-entrant tachycardia
CABG = coronary artery bypass grafting
CAD = coronary artery disease
ECG = electrocardiogram
MI = myocardial infarction

radiofrequency ablation of accessory pathways or atrioventricular nodal re-entrant tachycardia (AVNRT).

METHODS

Study patients. The study population consisted of 894 consecutive patients who underwent catheter ablation of accessory pathways (n = 519, 58.1%) and/or AVNRT (n = 379, 42.4%) during a 43-month period in the Department of Cardiology at the University of Muenster in Germany. Four patients underwent both accessory pathway and AVNRT ablation.

Of these 894 patients, 418 (46.8%) were male and 476 (53.2%) female. Accessory pathway ablation was performed in 296 of 418 (70.8%) male and in 223 of 476 (46.8%) female patients ($p < 0.001$). The AVNRT ablation was performed in 124 (29.7%) male and in 255 (53.6%) female patients ($p < 0.001$).

Radiofrequency ablation. Patients gave written informed consent before the procedure. The radiofrequency catheter ablation techniques we used have been described in detail previously (24,25). In brief, the retrograde aortic approach via the femoral artery was used for left-sided accessory pathways. Right-sided accessory pathways were approached via the femoral veins. Slow pathway ablation was performed for ablation of AVNRT. Temperature-guided energy application was used. Patients were monitored for 36 to 48 h after the procedure. A 12-lead electrocardiogram (ECG) was obtained before discharge.

The reported radiation dose is the dose-area product as measured by a dose-area product meter (Diamentor D, PTW, Freiburg, Germany).

Follow-up. The patients were seen 6 and 12 months after ablation in the hospital or by the referring physician. Furthermore, patient reports concerning clinical course, symptoms, and medication, as well as ECGs, were regularly sent to us by the referring physicians. Because the great majority of the patients were referred by regularly referring physicians, mostly cardiologists practicing in Muenster and its environs, such follow-up data could be obtained for most patients.

Statistical analysis. Data are presented as mean ± 1 SD. To evaluate differences between male and female patients, the chi-square test was used for dichotomous variables. Continuous variables were compared by the Mann-Whitney Rank Sum test. A p value of <0.05 was considered significant. Analyses were performed with the software package SigmaStat version 2.0 (SPSS Science, Chicago, Illinois).

Table 1. Patient Characteristics

	Male (n = 418)	Female (n = 476)	p Value
Age (yrs)	43 ± 15 (6–82)	43 ± 15 (13–76)	NS
Symptom duration before ablation (months)	157 ± 144	185 ± 143	<0.001
No. of antiarrhythmic drugs before ablation	1.3 ± 1.1	1.6 ± 1.2	<0.001
No. of patients with >1 tachycardia episode per month	294 (70.3)	382 (80.3)	<0.001
Heart rate during tachycardia (beats/min)	182 ± 27	189 ± 31	0.001

Data are expressed as number (%) of patients or mean value ± SD; range is given in parentheses.
NS = not significant.

RESULTS

Anamnestic data. Patient characteristics are given in Table 1. In brief, female patients were referred for ablation on an average of 28 months later after onset of symptoms than male patients, and after having been given more antiarrhythmic drugs. In addition, female patients were more symptomatic, with a higher number of patients having frequent tachycardia episodes (more than one episode per month) at the time of referral. Heart rate during tachycardia was slightly higher in women. Symptom duration before ablation was defined as time interval from the first reported symptoms.

Symptom duration before ablation was shorter in younger than in older patients and was significantly shorter in male than in female patients in both age groups: 100 ± 88 months in male (n = 178) versus 125 ± 93 months in female (n = 207) patients ≤40 years of age ($p = 0.005$); 199 ± 161 months in men (n = 240) versus 230 ± 156 months in women (n = 269) >40 years of age ($p = 0.015$).

We also compared symptom duration and number of antiarrhythmic drugs in men and women separately in two groups: in patients with pre-excitation in the resting ECG (i.e., with overt accessory pathways) and in patients without pre-excitation in the resting ECG. This second group contained the patients with concealed accessory pathways and the patients with AVNRT. In the first group (with pre-excitation), symptom duration was 161 ± 150 months in men (n = 222) versus 176 ± 145 months in women (n = 161), p = NS; number of antiarrhythmic drugs before ablation was 1.0 ± 1.0 in men versus 1.4 ± 1.1 in women ($p = 0.002$). In the second group (without pre-excitation), symptom duration was 154 ± 137 months in male (n = 196) versus 189 ± 141 in female (n = 315) patients, $p = 0.002$; number of antiarrhythmic drugs was 1.5 ± 1.2 in men versus 1.6 ± 1.3 in women, p = NS.

Table 2. Procedure Parameters

	Accessory Pathway Ablations			AVNRT Ablations			Total Ablations		
	Male (n = 345)	Female (n = 258)	p	Male (n = 132)	Female (n = 270)	p	Male (n = 474)	Female (n = 523)	p
Fluoroscopy time (min)	46.8 ± 45.2	43.8 ± 35.2	NS	27.5 ± 26.2	28.3 ± 43.0	NS	41.4 ± 41.7	35.7 ± 40.3	<0.001
Radiation dose (cGy × cm^2)	4,731 ± 5,331	3,601 ± 3,564	0.01	2,717 ± 2,336	2,108 ± 2,435	<0.001	4,157 ± 4,766	2,842 ± 3,139	<0.001
No. of RF applications	5.1 ± 5.3	4.3 ± 4.1	NS	3.3 ± 3.0	3.2 ± 3.3	NS	4.6 ± 4.8	3.7 ± 3.7	0.007
Procedure duration (min)	185 ± 94	197 ± 124	NS	138 ± 74	130 ± 68	NS	170 ± 91	161 ± 103	0.03

Data refer to ablation procedures and are expressed as mean value ± SD.
AVNRT = atrioventricular nodal re-entrant tachycardia; NS = not significant; RF = radiofrequency.

Procedure-related parameters and outcome. The number of ablation procedures performed was 997: 474 in male and 523 in female patients.

Procedure-related parameters are given in Table 2. Fluoroscopy time, number of radiofrequency applications, and procedure duration were similar in male and female subjects undergoing accessory pathway ablation as well as in male and female subjects undergoing AVNRT ablation. Owing to the higher proportion of AVNRT as underlying arrhythmia in women, female patients required a shorter fluoroscopy time and procedure duration and fewer energy applications in the total study population. Radiation dose was significantly lower in women.

The number of different ablation catheters used per procedure was also significantly lower in female patients (1.3 ± 0.6 vs. 1.5 ± 0.8 in male patients, $p < 0.04$).

Success and complications. Success rates were similar in male and female patients. In the total study population, ablation success was achieved in 390 (93%) male and 452 (95%) female patients (p = NS). To achieve these success rates, up to two additional ablation procedures were performed in 15 (3.6%) male and 16 (3.4%) female patients (p = NS). There was also no difference in success rates between men and women in patients with accessory pathway and with AVNRT ablation: in patients with accessory pathways, catheter ablation was successful in 271 (92%) male and 205 (92%) female patients (p = NS); in patients with AVNRT, successful ablation was performed in 121 (98%) male and 248 (97%) female patients (p = NS).

No procedure-related deaths occurred. Complication rates were similar in men and women. There were 38 (8.0%) complications in procedures performed in male patients and 54 (10.3%) in female patients (p = NS). These were of minor importance in most cases, including transient complete atrioventricular (AV) block, new bundle branch block, transient completely reversible neurological symptoms (hemianopsia, central scotoma, disorientation, etc.), femoral nerve paralysis, vascular complications (arteriovenous fistula, pseudoaneurysm), minor pericardial effusion not requiring treatment, conservatively treated retroperitoneal hematoma, and conservatively treated extensive groin hematoma.

Major complications included AV block with permanent pacemaker implantation, cardiac tamponade, left ventricular perforation necessitating surgical repair, cerebral infarction, and conservatively treated aortic dissection. No difference existed in the rate of major complications in procedures performed in male (n = 5, 1.1%) and female (n = 6, 1.1%) patients (p = NS).

Recurrences. Follow-up duration was 7.9 ± 5.5 months (range 1 to 36 months). Recurrence rates during follow-up were similar in men and women. In the total study population, recurrences after successful ablation occurred in 39 (10.0%) male and 33 (7.3%) female patients (p = NS). There was also no difference in recurrence rates between men and women in patients with accessory pathway and patients with AVNRT ablation: in patients with accessory pathways, recurrence was observed in 29 (10.7%) male and 21 (10.2%) female patients (p = NS); in patients with AVNRT ablation, recurrence occurred in 10 (8.3%) male and 12 (4.8%) female patients (p = NS).

DISCUSSION

The present study demonstrates significant gender differences in the referral policy for radiofrequency catheter ablation therapy. Female patients are referred for ablation later than male patients are (i.e., after a significantly longer duration of symptoms, after having been given more antiarrhythmic drugs, and with more severe symptoms). The outcome is the same in both genders, with no difference in success, complication, and recurrence rates.

Currently, catheter ablation therapy is treatment modality of first choice for symptomatic patients with supraventricular reentrant tachycardia. Numerous previous reports have proven the excellent results of this therapy form, with high success, low complication, and low recurrence rates (1–6,24–26). These reports have shown that there is no difference in success, complication, and recurrence rates between men and women (4–6). However, almost no data exist on possible gender-related differences in other aspects of ablation therapy. To the best of our knowledge, our study is the first to investigate these differences.

The reason why physicians are more unwilling to refer female patients rather than male patients is not completely evident. A possible explanation would be a higher degree of concerns about potential consequences of radiation exposure in women. Considering the relatively high proportion of young patients among subjects presenting with supraventricular reentrant tachycardia, these concerns could also regard reproduction-associated consequences. Previous re-

ports also suggest that symptoms of paroxysmal supraventricular tachycardia are more likely to be attributed to panic, anxiety, or stress in women than in men, thus delaying the diagnosis of supraventricular tachycardia (27). It may also be that women do prefer not to undergo procedures for the following reasons: concerns about safety or because they suffer less than men; are able to tolerate a similar degree of incapacitation more than men can; are more concerned about who is taking care of their children; seeing themselves as less important than men might see themselves.

However, potential concerns on behalf of physicians or female patients do not seem to be justified by the further results of our study. Ablation procedures in women had equally excellent success and equally low recurrence rates with those of men. Also, no differences existed in fluoroscopy time, radiofrequency applications, and procedure duration between male and female patients undergoing accessory pathway ablation as well as between male and female patients undergoing AVNRT ablation. In the total study population, ablations in women had shorter fluoroscopy and procedure times and fewer energy applications. This was due to the higher proportion of AVNRT as underlying arrhythmia in women, as AVNRT ablations were characterized by shorter procedure and fluoroscopy duration and less radiofrequency applications than were accessory pathway ablations.

A factor that was found to affect delay in referral was the presence of pre-excitation in the resting ECG. Differences in symptom duration before ablation were mainly due to later referral of women compared to men in patients without pre-excitation, whereas no significant difference existed in symptom duration between men and women exhibiting pre-excitation in the resting ECG. A possible explanation for this fact is that a delta wave is objective and in most cases easily recognizable. This would possibly limit differences between men and women in the time required to establish the diagnosis and prevent attribution of symptoms to panic, anxiety, or stress. Furthermore, the presence of a delta wave would probably limit possible fear of AV block associated with the ablation procedure. Such fear could be present in patients with presumed diagnosis of AVNRT due to the higher risk of AV block associated with AVNRT ablation compared to pathway ablation.

A gender-related difference in radiation exposure with higher radiation dose in men was also noted in a previous report of Rosenthal et al. (28). Fluoroscopy duration in the present study was similar to the one reported by Calkins et al. (29) and Kalbfleisch et al. (3) and somewhat shorter than that reported by Rosenthal et al. (28). Our data on procedural outcome are similar with the success, complication, and recurrence rates reported by previous studies (4–6, 26,30,31).

Anatomical gender differences could in theory affect procedure outcomes. Earlier studies have shown that women have a smaller heart size and smaller coronary artery diameter (7–10). These differences are at least partially due to the smaller body size of women (8,9). Together with a higher frequency of comorbidities at presentation, they have been considered to be one of the factors explaining findings of previous studies reporting a worse outcome of CABG surgery but also coronary intervention in female patients (9,11–14). Radiofrequency ablation is based on catheter manipulation inside the heart chambers. Therefore, smaller chamber size in women could theoretically influence the ease of performance of ablation procedures and, thus, success and complication rates. Our findings did not confirm this hypothesis.

Although our findings are novel in the field of radiofrequency ablation of arrhythmias, they confirm several previous reports demonstrating a less aggressive approach and a potential underuse of medical resources among female patients in different fields of cardiology and in medicine in general (15–23). Thus, it has been reported that women with CAD undergo cardiac catheterization less often and are referred for coronary revascularization less often and later in the course of their disease than are men (15–18). Other investigations have shown that women with acute MI have a longer prehospital delay, a lower thrombolysis rate, and undergo coronary angiography, coronary intervention, and CABG less often than men (19–22). Such differences are not confined to cardiology; they have also been reported in other fields of medicine (23).

Study limitations. A limitation of the study is the retrospective collection of data. A further limitation is the fact that we only included patients with accessory pathways and AVNRT. This could limit the generalizability of our findings to patients undergoing other ablation procedures.

We presented data on symptom duration before ablation. Symptom duration was defined as the time interval from the first reported symptoms. We do not have data on the time interval from first diagnosis to ablation. Such data would have been helpful in better characterization of referral delay in women by differentiating between delay in diagnosis and delay in referral for ablation after diagnosis.

Conclusions. Physicians and/or patients tend toward a more conservative approach in female patients. Women are referred for ablation later than are men, after a longer duration of symptoms, and after having been given more antiarrhythmic drugs. However, potential concerns on behalf of physicians or female patients do not seem to be justified: ablation procedures in women had equally high success, low complication, and low recurrence rates as procedures in male patients.

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